

What Is Claimed Is:

- 1 1. An apparatus for imaging radio frequency electromagnetic signals
2 comprising:
3 an optical source operable to output an unmodulated optical signal;
4 an image sensor operable to receive the unmodulated optical signal and an
5 incident radio frequency electromagnetic signal and to modulate the unmodulated
6 optical signal with the received radio frequency electromagnetic signal so as to
7 form a modulated optical signal;
8 a lens operable to receive the modulated optical signal and to focus the
9 modulated optical signal; and
10 a photodetector operable to receive the focused modulated optical signal
11 and output an electrical signal representing the focused modulated optical signal.
- 1 2. The apparatus of claim 1, wherein the optical source is a laser.
- 1 3. The apparatus of claim 1, wherein the image sensor comprises:
2 a plurality of cells, each cell comprising:
3 a first electro-optically active optical waveguide;
4 a first planar electrode substantially parallel to the waveguide;
5 a second electro-optically active optical waveguide;

6 a second planar electrode substantially parallel to the second waveguide,
7 the first and second planar electrodes being substantially adjacent and coplanar;
8 and
9 a third planar electrode substantially parallel to the first and second planar
10 electrodes and disposed such that the first waveguide lies between the first and
11 third planar electrodes, and the second waveguide lies between the second and
12 third planar electrodes.

1 4. The apparatus of claim 3, wherein the optical source is coupled to a first
2 end of each of the waveguides.

1 5. The apparatus of claim 4, further comprising:
2 an output optical waveguide coupled to the second end of each of the first
3 and second waveguides.

1 6. The apparatus of claim 5, further comprising:
2 a coupler electrically connecting the first and third planar electrodes,
3 whereby the first and third planar electrodes are kept at substantially the same
4 electrical potential.

1 7. The apparatus of claim 6, further comprising:

2 a polymer layer in which the waveguides are formed and to which the
3 planar electrodes are attached.

1 8. The apparatus of claim 7, wherein the first planar electrode is arranged so
2 that an incident radio frequency electromagnetic signal will impinge upon the first
3 planar electrode.

1 9. The apparatus of claim 3, wherein the third planar electrode comprises a
2 first portion and a second portion and is disposed such that the first waveguide lies
3 between the first planar electrode and the first portion of the third planar electrode,
4 and the second waveguide lies between the second planar electrode and the second
5 portion of the third planar electrode.

1 10. The apparatus of claim 9, wherein the optical source is coupled to a first
2 end of each of the waveguides.

1 11. The apparatus of claim 10, further comprising:
2 an output optical waveguide coupled to the second end of each of the first
3 and second waveguides.

1 12. The apparatus of claim 11, further comprising:

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2 a coupler electrically connecting the first planar electrode and the first and
3 second portions of the third planar electrode, whereby the first planar electrode
4 and the first and second portions of the third planar electrode are kept at
5 substantially the same electrical potential.

1 13. The apparatus of claim 12, further comprising:

2 a polymer layer in which the waveguides are formed and to which the
3 planar electrodes are attached.

1 14. The apparatus of claim 13, wherein the first planar electrode is arranged so
2 that an incident radio frequency electromagnetic signal will impinge upon the first
3 planar electrode.

1 15. The apparatus of claim 1, wherein the photodetector is an array of
2 photodiodes.

1 16. An apparatus for imaging radio frequency electromagnetic signals
2 comprising:

3 an imaging sensor operable to receive an incident radio frequency signal
4 and output a corresponding electrical signal; and

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5 a processor operable to receive the electrical signal and generate a signal
6 representing an image of the received radio frequency signal.

1 17. The apparatus of claim 16, further comprising a display operable to display
2 the signal representing an image of the received radio frequency signal.

1 18. The system of claim 16, wherein the imaging sensor comprises:
2 an optical source operable to output an unmodulated optical signal;
3 an image sensor operable to receive the unmodulated optical signal and an
4 incident radio frequency electromagnetic signal and to modulate the unmodulated
5 optical signal with the received radio frequency electromagnetic signal so as to
6 form a modulated optical signal;

7 a lens operable to receive the modulated optical signal and to focus the
8 modulated optical signal; and

9 a photodetector operable to receive the focused modulated optical signal
10 and output an electrical signal representing the focused modulated optical signal.

1 19. The apparatus of claim 18, wherein the optical source is a laser.

1 20. The apparatus of claim 18, wherein the image sensor comprises:
2 a plurality of cells, each cell comprising:

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3 a first electro-optically active optical waveguide;
4 a first planar electrode substantially parallel to the first waveguide;
5 a second electro-optically active optical waveguide;
6 a second planar electrode substantially parallel to the second waveguide,
7 the first and second planar electrodes being substantially adjacent and coplanar;
8 and
9 a third planar electrode substantially parallel to the first and second planar
10 electrodes and disposed such that the first waveguide lies between the first and
11 third planar electrodes, and the second waveguide lies between the second and
12 third planar electrodes.

1 21. The apparatus of claim 20, wherein the optical source is coupled to a first
2 end of each of the waveguides.

1 22. The apparatus of claim 21, further comprising:
2 an output optical waveguide coupled to the second end of each of the first
3 and second waveguides.

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1 23. The apparatus of claim 22, further comprising:

2 a coupler electrically connecting the first and third planar electrodes,
3 whereby the first and third planar electrodes are kept at substantially the same
4 electrical potential.

1 24. The apparatus of claim 23, further comprising:

2 a polymer layer in which the waveguides are formed and to which the
3 planar electrodes are attached.

1 25. The apparatus of claim 24, wherein the first planar electrode is arranged so
2 that an incident radio frequency electromagnetic signal will impinge upon the first
3 planar electrode.

1 26. The apparatus of claim 20, wherein the third planar electrode comprises a
2 first portion and a second portion and is disposed such that the first waveguide lies
3 between the first planar electrode and the first portion of the third planar electrode,
4 and the second waveguide lies between the second planar electrode and the second
5 portion of the third planar electrode.

1 27. The apparatus of claim 26, wherein the optical source is coupled to a first
2 end of each of the waveguides.

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1 28. The apparatus of claim 27, further comprising:
2 an output optical waveguide coupled to the second end of each of the first
3 and second waveguides.

1 29. The apparatus of claim 28, further comprising:
2 a coupler electrically connecting the first planar electrode and the first and
3 second portions of the third planar electrode, whereby the first planar electrode
4 and the first and second portions of the third planar electrode are kept at
5 substantially the same electrical potential.

1 30. The apparatus of claim 29, further comprising:
2 a polymer layer in which the waveguides are formed and to which the
3 planar electrodes are attached.

1 31. The apparatus of claim 30, wherein the first planar electrode is arranged so
2 that an incident radio frequency electromagnetic signal will impinge upon the first
3 planar electrode.

1 32. The apparatus of claim 18, wherein the photodetector is an array of
2 photodiodes.

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1 33. A system for imaging a target using imaging radio frequency
2 electromagnetic signals comprising:

3 an illuminator operable to radiate radio frequency electromagnetic signals
4 so as to illuminate the target; and

5 an imaging apparatus operable to receive radio frequency electromagnetic
6 signals reflected from the target and to image the received radio frequency
7 electromagnetic signals.

1 34. The system of claim 33, wherein the illuminator comprises:

2 a radio frequency transmitter operable to output a radio frequency electrical
3 signal; and

4 a transmitting antenna coupled to the radio frequency electrical signal and
5 operable to radiate a radio frequency electromagnetic signal.

1 35. The system of claim 33, wherein the imaging apparatus comprises:

2 an imaging sensor operable to receive an incident radio frequency signal
3 and output a corresponding electrical signal; and

4 a processor operable to receive the electrical signal and generate a signal
5 representing an image of the received radio frequency signal.

1 36. The apparatus of claim 35, further comprising a display operable to display
2 the signal representing an image of the received radio frequency signal.

1 37. The system of claim 36, wherein the imaging sensor comprises:
2 an optical source operable to output an unmodulated optical signal;
3 an image sensor operable to receive the unmodulated optical signal and an
4 incident radio frequency electromagnetic signal and to modulate the unmodulated
5 optical signal with the received radio frequency electromagnetic signal so as to
6 form a modulated optical signal;
7 a lens operable to receive the modulated optical signal and to focus the
8 modulated optical signal; and
9 a photodetector operable to receive the focused modulated optical signal
10 and output an electrical signal representing the focused modulated optical signal.

1 38. The apparatus of claim 37, wherein the optical source is a laser.

1 39. The apparatus of claim 37, wherein the image sensor comprises:
2 a plurality of cells, each cell comprising:
3 a first electro-optically active optical waveguide;
4 a first planar electrode substantially parallel to the first waveguide;
5 a second electro-optically active optical waveguide;

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6 a second planar electrode substantially parallel to the second waveguide,
7 the first and second planar electrodes being substantially adjacent and coplanar;
8 and

9 a third planar electrode substantially parallel to the first and second planar
10 electrodes and disposed such that the first waveguide lies between the first and
11 third planar electrodes, and the second waveguide lies between the second and
12 third planar electrodes.

1 40. The apparatus of claim 39, wherein the optical source is coupled to a first
2 end of each of the waveguides.

1 41. The apparatus of claim 40, further comprising:

2 an output optical waveguide coupled to the second end of each of the first
3 and second waveguides.

1 42. The apparatus of claim 41, further comprising:

2 a coupler electrically connecting the first and third planar electrodes,
3 whereby the first and third planar electrodes are kept at substantially the same
4 electrical potential.

1 43. The apparatus of claim 42, further comprising:

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2 a polymer layer in which the waveguides are formed and to which the
3 planar electrodes are attached.

1 44. The apparatus of claim 43, wherein the first planar electrode is arranged so
2 that an incident radio frequency electromagnetic signal will impinge upon the first
3 planar electrode.

1 45. The apparatus of claim 39, wherein the third planar electrode comprises a
2 first portion and a second portion and is disposed such that the first waveguide lies
3 between the first planar electrode and the first portion of the third planar electrode,
4 and the second waveguide lies between the second planar electrode and the second
5 portion of the third planar electrode.

1 46. The apparatus of claim 45, wherein the optical source is coupled to a first
2 end of each of the waveguides.

1 47. The apparatus of claim 46, further comprising:
2 an output optical waveguide coupled to the second end of each of the first
3 and second waveguides.

1 48. The apparatus of claim 47, further comprising:

2 a coupler electrically connecting the first planar electrode and the first and
3 second portions of the third planar electrode, whereby the first planar electrode
4 and the first and second portions of the third planar electrode are kept at
5 substantially the same electrical potential.

1 49. The apparatus of claim 48, further comprising:

2 a polymer layer in which the waveguides are formed and to which the
3 planar electrodes are attached.

1 50. The apparatus of claim 49, wherein the first planar electrode is arranged so
2 that an incident radio frequency electromagnetic signal will impinge upon the first
3 planar electrode.

1 51. The apparatus of claim 33, wherein the photodetector is an array of
2 photodiodes.

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